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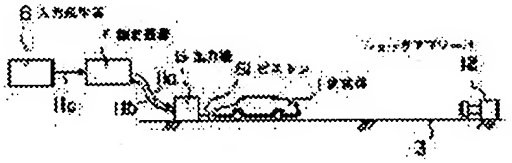
(54) CAR COLLISION SIMULATOR AND CAR COLLISION SIMULATION TESTING METHOD

(57)Abstract:

PURPOSE: To reduce the test cost in the nondestructive collision test of an automobile, to shorten the test time, to improve test accuracy and to make a tester (land for test) compact.



CONSTITUTION: A test specimen (white body with wheels) 1 is arranged to face a power applying machine 6 in such a manner that a dummy doll faces this power applying machine 6. A piston 61 of the power applying machine 6 is brought into contact with the hard point of the test specimen I in the state of holding this piston 61 at the stroke end on a contraction side and an input signal for setting a target deceleration waveform is applied to a control apparatus 7 from an input generator 8 in order to apply a target acceleration (deceleration to the car) to the test specimen 1. The piston 61 of the power applying machine 6 is actuated to push the test specimen 1 by control of this control apparatus 7 according to the input signal. The test specimen 1 moving at the constant speed after the test specimen is pushed by the power applying machine 6 is stopped by a shock absorber 12.

CLAIMS

[Claim(s)]

[Claim 1] The vehicle collision simulator characterized by to provide an force-application control system including an input generating means output the input signal for determining the above-mentioned target deceleration as the specimen concerned to the force-application machine for giving target deceleration, the control means which controls this force-application machine, and this control means by pushing specimens, such as the White body with a wheel of an automobile, and the shock absorber for stopping the above-mentioned specimen which moves by constant speed after pushed with the above-mentioned force-application machine.

[Claim 2] Specimens, such as the White body of an automobile, are carried and fixed. A movable table cart, The force application machine for giving target deceleration to the above-mentioned specimen by pushing this table cart, An force application control system including an input generating means to output the input signal for determining the above-mentioned target deceleration to the control means which controls this force application machine, and this control means, The vehicle collision simulator characterized by providing the shock absorber for stopping the above-mentioned table cart which moves by constant speed after being pushed with the above-mentioned force application machine.

[Claim 3] The vehicle collision simulation test method characterized by making it make a shock absorber stop the above-mentioned specimen which carries out constant-speed migration by giving target deceleration to the specimen concerned by pushing specimens, such as the White body with a wheel of an automobile, with an force application machine, suspending the force application actuation by the force application machine after an appropriate time, and carrying out constant-speed migration of the above-mentioned specimen while performing non-destroying collision simulation of an automobile.

[Claim 4] The vehicle collision simulation test method which carries out [having made it make a shock absorber suspend the above-mentioned table cart which carries out constant-speed migration, and] as the description while performing the non-destroying collision simulation of an automobile by carrying and fixing specimens, such as the White body of an automobile, at a table cart, giving target deceleration to the above-mentioned specimen by pushing this table cart with an force-application machine, suspending the force-application actuation by the force-application machine after an appropriate time, and carrying out the constant-speed migration of the above-mentioned table cart.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the suitable vehicle collision simulator for the non-destroying collision test of an automobile, and a vehicle collision simulation test method.
[0002]
[Description of the Prior Art] Generally, the collision test of an automobile is divided roughly into the real collision test for evaluating the amount of crash, and the amount of ullages, and the non-destroying collision acceleration simulation (non-destroying collision G simulation) for evaluating the crew personal protective equipment represented by an airbag system and the seat belt.
[0003] This invention relates to the non-destroying collision G simulator for this latter (non-destroying collision G simulation). A trial by this G simulator gives target acceleration (moderation acceleration in the car [by collision]) to the CABIN part of the White body with a wheel of the ******(ed) automobile (specimen), the effect which crew personal protective equipment and a layout in the car have on an inner dummy doll is evaluated at the time of a collision, and it is carried out in order to do research and development in a safe vehicle.
[0004] Conventionally, this kind of trial has been carried out by the mechanical method shown in drawing 9 . That is, it makes it stop a specimen 1 with the mechanical stoppers 5 formed in the wall 4 grade, such as a lead pad and an oleo damper, so that target acceleration may generate the specimens 1, such as the White body with a wheel which set a dummy doll and crew personal protective equipment, into the CABIN part of a specimen 1 in the place which became a target rate on tension and the transit way 3 with the wire 13 in the winch 2 grade to un-destroy.
[0005]
[Problem(s) to be Solved by the Invention] The technical problem enumerated below occurred in such a conventional test method.
(1) A transit way becomes long (about [Usually about 100] m), and needs a vast trial lot.
[0006] (2) Whenever a test condition changes, a mechanical stopper needs to be adjusted, the time amount loss by trial-and-error is also large, and acceleration wave precision and its repeatability are also bad.
(3) There is a possibility that a specimen may be damaged.
[0007] In order that the trial according to the conventional non-destroying collision G simulator for the above technical problem may hold two major themes called the problem of the trial cost resulting from the increment in the number of specimens, the increment in test time, a vast trial lot, etc., and the problem on the test evaluation resulting from acceleration wave precision etc. and may lower the price of an automobile with crew personal protective equipment, it is globally anxious for the new type G simulator which solves the above-mentioned technical problem.
[0008] This invention was made in consideration of the above-mentioned situation, and the purpose is in offering the vehicle collision simulator and vehicle collision simulation test method which can aim at reduction of the trial cost of the non-destroying collision test of an automobile, and improvement in trial precision.
[0009]
[Means for Solving the Problem] The vehicle collision simulator (vehicle collision acceleration simulator) concerning this invention The force application machine for giving target deceleration to the specimen concerned by merely pushing, without grasping specimens, such as the White body with a wheel of an automobile, An force application control system including an input generating means to output the input signal from the target decelerating wave which should be reproduced to the control means and specimen

(CABIN section of the White body of an automobile) which control this force application machine to the above-mentioned control means, After being pushed with an force application machine, it is characterized by having a shock absorber for stopping the specimen which moves by constant speed.
[0010] Moreover, this invention is characterized also by giving target deceleration at the specimen currently carried and fixed by the table cart by pushing a table cart instead of carrying and fixing a specimen and pushing a specimen with an force application machine like the above using a movable table cart smoothly forward and backward.
[0011]
[Function] In the above-mentioned configuration, a specimen is opposed to an force application (force application machine is seen like [the dummy doll set to the interior]) machine, and the hardpoint of a specimen and the tip of the force application part of an force application machine are contacted. If this force application part is the example of the force application machine which consists of pistons, where the piston of an force application machine is made into the stroke edge by the side of shrinkage, the hardpoint and the piston of a specimen will be contacted. And from this condition, a specimen is pushed with an acceleration control system by actuation of the piston of the force application machine according to control of a control means in order to give target acceleration (it is deceleration for a specimen, i.e., a vehicle) to a specimen. Actuation of a piston will be stopped, if the acceleration of a specimen is set to "0" with target acceleration and full speed is reached. Then, a specimen separates from a piston and shifts to uniform motion mostly by inertia. The condition (condition of 0G) of this acceleration "0" is equivalent to the vehicle speed after an actual vehicle collision "0", i.e., the condition of car-body quiescence, and the dummy doll in a specimen (inside of CABIN of a vehicle) is a part of test evaluation period which is still exercising. The specimen after this evaluation is safely stopped by the shock absorber without damage.
[0012] Moreover, when it considers as the configuration which pushes the table cart concerned with an force application machine using the table cart which carried and fixed the specimen, it is not necessary to necessarily use the White body with a wheel, and it becomes possible as a specimen to use the White body of a mere vehicle.
[0013]
[Example] Hereafter, the example of this invention is explained, referring to a drawing.
[1st example] drawing 1 is the system configuration Fig. showing the 1st example of the non-destroying collision G simulator for automatic persons of this invention (non-destroying collision acceleration simulator for automatic persons). In addition, the same sign is given to the same part as drawing 9 .
[0014] In drawing 1 , 6 is the force application machine equipped with the piston 61. By driving a piston 61, this force application machine 6 can give target deceleration to the specimen 1 concerned, without grasping specimens (White body with the wheel of the automobile which set a dummy doll and crew personal protective equipment etc.) 1, and is come. The piston 61 of the force application machine 6 is equipped with the position sensor and the acceleration sensor (not shown).
[0015] The control equipment 7 for controlling the force application machine 6 concerned is connected to the force application machine 6 through the control measurement cables 11a and 11b. Moreover, the input generator 8 which outputs the input signal to the control equipment 7 concerned determined from the target decelerating wave which should be reproduced in the CABIN section of a specimen 1 is connected to the control equipment 7 through control measurement cable 11c.
[0016] The position sensor and acceleration sensor with which the piston 61 of the above force application machine 6, a control equipment 7, the input generator 8, and the force application machine 6 was equipped constitute an force application control system. This force application control system (force application machine 6) is realized by actuators, such as for example, an electrohydraulic-servomechanism type or a **** type.
[0017] After being pushed with the force application machine 6 ahead of piston 61 tip of the force application

machine 6, the shock absorber 12 for making it stop without damage of the specimen 1 which moves by constant speed is formed.

[0018] Next, the non-destroying collision test (non-destroying collision G simulation trial) by the non-destroying collision G simulator for automatic persons of the configuration of drawing 1 is explained. First, the force application machine 6 is made to face and it arranges, and where the piston 61 of the force application machine 6 is made into the stroke edge by the side of shrinkage, this piston 61 is contacted to the hardpoint of a specimen 1, so that the dummy doll set to the specimen 1 concerned in the specimen 1 may look at the force application machine 6.

[0019] From this condition, with an acceleration control system, i.e., control of the control equipment 7 which gives the input signal for setting up a target decelerating wave from the input generator 8 to a control equipment 7, and follows that input signal, the piston 61 of the force application machine 6 is operated, and a specimen 1 is pushed in order to give target acceleration (it is deceleration for a specimen 1, i.e., a vehicle) to a specimen 1. the target corresponding to a target decelerating wave in this input signal -- a variation rate -- it is a wave. The simplest decision approach of this target displacement wave is integrating with a target decelerating wave (target acceleration wave) twice. However, when a displacement wave is determined only by count, even if this displacement wave is reproduced with high precision by the feedback control of a control equipment 7, the actual acceleration wave in which a monitor is carried out by the acceleration sensor is not necessarily in agreement with a target acceleration wave. in such a case, a target -- a variation rate -- a wave -- the control equipment 7 from the input generator 8 -- giving -- the variation rate of a specimen 1 (piston 61 to push) -- the target concerned -- a variation rate -- the monitor of the acceleration (response acceleration) detected by the acceleration sensor with which the piston 61 of the force application machine 6 was equipped is carried out, carrying out feedback control of the force application machine 6 by the control equipment 7 so that it may be in agreement with a wave. and the target which suited the actual control system which can be brought more close to target acceleration from the gap with this acceleration (response acceleration) and target acceleration that carried out the monitor -- a variation rate -- a wave is determined and it is made to output from the input generator 8 the optimal target to give a target acceleration wave by repeating this procedure several times -- a variation rate -- a wave is determined.

[0020] now -- while a control equipment 7 detects the variation rate and acceleration of a specimen 1 by the position sensor and acceleration sensor which were equipped by the piston 61 -- the variation rate of a specimen 1 -- a target -- a variation rate -- feedback control of the force application machine 6 is carried out so that it may be in agreement with a wave. And the acceleration of a specimen 1 is set to "0" with target acceleration, and a control equipment 7 will stop actuation of a piston 61, if it detects having reached full speed.

[0021] If it carries out like this, a specimen 1 will separate from a piston 61 and will shift to uniform motion mostly by inertia. The condition (condition of 0G) of this acceleration "0" is equivalent to the vehicle speed after an actual vehicle collision "0", i.e., the condition of car-body quiescence, and the dummy doll in a specimen 1 (inside of CABIN of a vehicle) is a part of test evaluation period which is still exercising. The specimen 1 after this evaluation is safely stopped by the shock absorber 12 without damage.

[0022] By the non-destroying collision G simulator for automatic persons of the configuration of drawing 1 described above The frequency response characteristic of the control system which consists of an above-mentioned force application control system and a specimen 1 compares with the main frequency components of a target acceleration wave. In being sufficiently high The above-mentioned force application control function 1, i.e., a specimen, the force application (force application machine 6 is seen like [a dummy doll]) machine 6 and facing each other, The expected trial purpose can be attained by contacting the hardpoint and the piston 61 of a specimen 1, where the piston 61 of the force application machine 6 is made into the stroke edge by the side of shrinkage, and giving target acceleration to a specimen 1 from this condition.

[0023] On the other hand, when the frequency response characteristic of the control system which consists of

an force application control system and a specimen 1 cannot say that it is sufficiently high compared with the main frequency components of a target acceleration wave, the configuration of drawing 1 is inadequate.
[0024] The [2nd example] The 2nd example of this invention suitable when the frequency response characteristic of the control system which consists of an force application control system and a specimen 1 cannot say that it is sufficiently high there compared with the main frequency components of a target acceleration wave is explained with reference to drawing 2 . In addition, the same sign is given to the same part as drawing 1 , and detailed explanation is omitted.
[0025] When the frequency response characteristic of a control system cannot say that it is sufficiently high compared with the main frequency components of a target acceleration wave, he compensates a target acceleration wave with this example using the frequency response characteristic of the control system beforehand grasped by trial excitation, and is trying to apply the technique (the so-called input compensation technique) of considering this as an input by it first.
[0026] When applying this input compensation technique, at the time of trial excitation, oscillating excitation which usually carries out push length of the specimen 1 by the suitable input wave is performed. Then, he is trying to combine the hardpoint of a specimen 1, and piston 61 tip of the force application machine 6 with the joint fixtures 9, such as a bolt, in this example, for this oscillating excitation (trial excitation), as shown in drawing 2 .
[0027] The hardpoint of a specimen 1, and piston 61 tip of the force application machine 6 in and the condition of having joined together with the joint fixture 9 Oscillating excitation (trial excitation) which expands and contracts the piston 61 of the force application machine 6, and carries out push length of the specimen 1 is performed. At the time of this excitation (non-destroying collision G simulation) after extracting the frequency response characteristic of the control system which consists of an force application system and a specimen 1, the joint fixture 9 is removed, association is solved, and it is made the same system state as said 1st example shown in drawing 1 . The function at the time of this excitation in this condition is the same as that of said 1st example, if the point which compensates a target acceleration wave using the frequency response characteristic of the control system grasped by the above-mentioned trial excitation, and considers this as the input from the input generator 8 is removed.
[0028] By the way, in order for the above examples [1st and 2nd] to become applicable, conditions are attached to target acceleration so that it may state below. Usually, as target acceleration is shown in drawing 4 , several 100Hz RF is on the fundamental wave of the letter of a half sign. When there may not be a time zone when target acceleration becomes "+" (plus) like the example of this drawing 4 , or there may be time amount which becomes "+" even if or the acceleration of that time amount may be cut by "0" from the trial purpose, application of the 1st and 2nd examples is attained.
[0029] On the other hand, when not satisfying the conditions of the above [target acceleration] (for example, when there is a time zone when a target rate becomes "+" (plus) like drawing 5), the 1st and 2nd examples are insufficient.
[0030] The [3rd example] There, case [whose target acceleration is / like drawing 5], the 3rd example of suitable this invention is explained with reference to drawing 3 . In addition, the same sign is given to the same part as drawing 1 , and detailed explanation is omitted.
[0031] First, by this example, as shown in drawing 3 , the high response joint change-over device 10 which enables association with the hardpoint of a specimen 1 and piston 61 tip of the force application machine 6 and joint discharge and which is constituted by the oil pressure chuck, an electromagnet, etc. is established. This high response joint change-over device 10 is controlled from a control equipment 7 through control measurement cable 11d. Namely, the period when target acceleration is changed sharply ["+" and "-"] combines the hardpoint of a specimen 1, and piston 61 tip of the force application machine 6, and, as for the high response joint change-over device 10, acceleration cancels the above-mentioned association to a high response at the moment of becoming "0" continuation with the synchronizing signal given through control

measurement cable 11d from a control equipment 7.
[0032] What is necessary is to always set the high response joint change-over device 10 as the integrated state at the time of trial excitation, to carry out frequency-characteristics grasp of a system with an integrated state, and for the synchronizing signal from a control equipment 7 to cancel the high response joint change-over device 10 of an integrated state, and just to switch by this next excitation (non-destroying collision G simulation), in such a configuration, even when input compensation which was stated in said 2nd example is required.
[0033] According to the above the 1st thru/or 3rd example, the example effectiveness of enumerating below can be acquired.
(1) the mileage of a specimen 1 -- the product of the target rate at the time of a trial, and the trial averaging time of the above "0G" -- being decided -- at most -- it is settled in the short distance not more than about 10m.
[0034] (2) All strokes of the force application machine 6 are value extent which integrated with the target acceleration wave twice, and are restored at most to 1m or less. There is also no fall of **** rigidity of the force application machine 6 which poses a problem for this short stroke (for example, an electrohydraulic-servomechanism type), large G excitation in high frequency is possible, and a feedback control method serves as acceleration wave precision and an efficient system excellent in repeatability conjointly.
[0035] (3) There is no limit from the trial purpose, the design which makes acceleration small without limit can be possible, for this reason, there can be no damage in a shock absorber 12 in any way about a specimen 1 as a matter of fact, it can be unhurt to it, and it can be made to suspend it safely.
[0036] It corresponds to above-mentioned example effectiveness (1) technical-problem [which was stated in the column of [Problem(s) to be Solved by the Invention]] (1) - (3), new G simulator by this example has solved all the main technical problems that the conventional G simulator has, and - (3) does not have a new technical problem.
[0037] In addition, in the above the 1st thru/or 3rd example, if the sense of a specimen 1 is carried out reversely (condition that a dummy doll turns the back to the force application machine 6), with drawing and a shock absorber 12 is replaced with a **** collision wall, of course, the usual destructive collision test stated in the column of [Description of the Prior Art] can be conducted.
[0038] Moreover, in the above the 1st thru/or 3rd example, as the specimen 1 was shown in drawing 1 thru/or drawing 3 that it was the White body with a wheel etc., although the specimen 1 was pushed directly, it does not restrict to this by actuation of the piston 61 of the force application machine 6.
[0039] For example, the expected trial purpose can be attained like said the 1st thru/or 3rd example by using the mere White body of a vehicle as a specimen, carrying and fixing the specimen concerned, forming a movable table cart smoothly and pushing this table cart with an force application machine forward and backward.
[0040] The (it corresponds to said the 1st thru/or 3rd example) 4th thru/or the 6th example using this table cart is explained with reference to drawing 6 (it corresponds to drawing 1 thru/or drawing 3) thru/or drawing 8 . In addition, the same sign is given to the same part as drawing 1 thru/or drawing 3 , and detailed explanation is omitted.
[0041] In [4th example] this example, as shown in drawing 6 , a specimen 21 is carried and fixed and the movable table cart 22 is formed smoothly forward and backward. The specimen 21 shown in drawing 6 is the mere White body (White body without a wheel) of a vehicle, is this point, and differ in the specimen 1 which is the White body with a wheel as shown in drawing 1 thru/or drawing 3 .
[0042] With the configuration of drawing 6 , where the piston 61 of the force application machine 6, and the facing each other and the force application machine 6 is made into the stroke edge by the side of shrinkage for the table cart 22 which carried and fixed the specimen 21, this piston 61 is contacted in the table cart 22.
[0043] From this condition, with an acceleration control system, i.e., control of the control equipment 7 which

gives the input signal for setting up a target decelerating wave from the input generator 8 to a control equipment 7, and follows that input signal, the piston 61 of the force application machine 6 is operated, and the table cart 22 is pushed in order to give target acceleration (it is deceleration for a specimen 21, i.e., a vehicle) to a specimen 21. The acceleration of the table cart 22 is set to "0" with target acceleration, and a control equipment 7 will stop actuation of a piston 61, if it detects having reached full speed.
[0044] If it carries out like this, the table cart 22 will separate from a piston 61, and will shift to uniform motion mostly by inertia. The condition (condition of 0G) of this acceleration "0" is equivalent to the vehicle speed after an actual vehicle collision "0", i.e., the condition of car-body quiescence, and the dummy doll in a specimen 21 (inside of CABIN of a vehicle) is a part of test evaluation period which is still exercising. The specimen 21 after this evaluation is safely stopped by the shock absorber 12 without damage with the table cart 22.
[0045] By the non-destroying collision G simulator for automatic persons of the configuration of drawing 6 described above, the frequency response characteristic of the control system which consists of an above-mentioned force application control system, a specimen 21, and a table cart 22 can attain the expected trial purpose by the above-mentioned force application control function, when sufficiently high compared with the main frequency components of a target acceleration wave.
[0046] When that is not right, the configuration of drawing 6 is inadequate and it is necessary to apply the 5th following example.
[5th example] this example apply the input compensation technique, and in order to perform oscillating excitation which usually carry out push length of the table cart 22 by the suitable input wave, he be trying to combine the edge of the table cart 22, and piston 61 tip of the force application machine 6 with the joint fixture 9 like said 2nd example, at the time of trial excitation, as show in drawing 7 . At the time of this next excitation (non-destroying collision G simulation), the joint fixture 9 is removed and association is solved. The function at the time of this excitation in this condition is the same as that of the 4th example.
[0047] By the way, as shown in drawing 5 , when there is a time zone when a target rate becomes "+" (plus), the 4th and 5th examples are insufficient.
The [6th example] There so that it can apply case [whose target acceleration is / like drawing 5] As shown in drawing 8 , the period when target acceleration is sharply changed to "+" and "-" using the high response joint change-over device 10 The edge of the table cart 22 and piston 61 tip of the force application machine 6 are combined according to the high response joint change-over device 10 concerned, and the configuration of which the above-mentioned association is canceled to a high response at the moment acceleration serves as "0" continuation is taken.
[0048] According to the above the 4th thru/or 6th example, the example effectiveness of enumerating below can be acquired.
(1) the mileage of the table cart 22 -- the product of the target rate at the time of a trial, and the trial averaging time of the above "0G" -- being decided -- at most -- it is settled in the short distance not more than about 10m.
[0049] (2) All strokes of the force application machine 6 are value extent which integrated with the target acceleration wave twice, and are restored at most to 1m or less. There is also no fall of **** rigidity of the force application machine 6 which poses a problem for this short stroke (for example, an electrohydraulic-servomechanism type), large G excitation in high frequency is possible, and a feedback control method serves as acceleration wave precision and an efficient system excellent in repeatability conjointly.
[0050] (3) There is no limit from the trial purpose, the design which makes acceleration small without limit can be possible, for this reason, there can be no damage in a shock absorber 12 in any way about a specimen 21 or the table cart 22 as a matter of fact, it can be unhurt to it, and it can be made to suspend it safely.
[0051] - (3) corresponds to above-mentioned example effectiveness (1) technical-problem [which was stated in the column of [Problem(s) to be Solved by the Invention]] (1) - (3), and new G simulator by this example

has solved all the main technical problems that the conventional G simulator has.

[0052]

[Effect of the Invention] As explained in full detail above, all the main technical problems that the conventional vehicle collision G simulator has according to this invention can be solved, reduction of trial cost, compaction of test time, improvement in trial precision, miniaturization that is a testing device (trial lot), and also reduction of the noise can be aimed at, therefore the price fall of an automobile with crew personal protective equipment can be expected.

TECHNICAL FIELD

[Industrial Application] This invention relates to the suitable vehicle collision simulator for the non-destroying

PRIOR ART

[Description of the Prior Art] Generally, the collision test of an automobile is divided roughly into the real collision test for evaluating the amount of crash, and the amount of ullages, and the non-destroying collision acceleration simulation (non-destroying collision G simulation) for evaluating the crew personal protective equipment represented by an airbag system and the seat belt.

[0003] This invention relates to the non-destroying collision G simulator for this latter (non-destroying collision G simulation). A trial by this G simulator gives target acceleration (moderation acceleration in the car [by collision]) to the CABIN part of the White body with a wheel of the ******(ed) automobile (specimen), the effect which crew personal protective equipment and a layout in the car have on an inner dummy doll is evaluated at the time of a collision, and it is carried out in order to do research and development in a safe vehicle.

[0004] Conventionally, this kind of trial has been carried out by the mechanical method shown in drawing 9 . That is, it makes it stop a specimen 1 with the mechanical stoppers 5 formed in the wall 4 grade, such as a lead pad and an oleo damper, so that target acceleration may generate the specimens 1, such as the White body with a wheel which set a dummy doll and crew personal protective equipment, into the CABIN part of a specimen 1 in the place which became a target rate on tension and the transit way 3 with the wire 13 in the winch 2 grade to un-destroy.

EFFECT OF THE INVENTION

[Effect of the Invention] As explained in full detail above, all the main technical problems that the conventional vehicle collision G simulator has according to this invention can be solved, reduction of trial cost, compaction of test time, improvement in trial precision, miniaturization that is a testing device (trial lot), and also reduction of the noise can be aimed at, therefore the price fall of an automobile with crew personal protective equipment can be expected.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] The technical problem enumerated below occurred in such a conventional test method.
(1) A transit way becomes long (about [Usually about 100] m), and needs a vast trial lot.
[0006] (2) Whenever a test condition changes, a mechanical stopper needs to be adjusted, the time amount loss by trial-and-error is also large, and acceleration wave precision and its repeatability are also bad.
(3) There is a possibility that a specimen may be damaged.
[0007] In order that the trial according to the conventional non-destroying collision G simulator for the above technical problem may hold two major themes called the problem of the trial cost resulting from the increment in the number of specimens, the increment in test time, a vast trial lot, etc., and the problem on the test evaluation resulting from acceleration wave precision etc. and may lower the price of an automobile with crew personal protective equipment, it is globally anxious for the new type G simulator which solves the above-mentioned technical problem.
[0008] This invention was made in consideration of the above-mentioned situation, and the purpose is in offering the vehicle collision simulator and vehicle collision simulation test method which can aim at reduction of the trial cost of the non-destroying collision test of an automobile, and improvement in trial precision.

MEANS

[Means for Solving the Problem] The vehicle collision simulator (vehicle collision acceleration simulator) concerning this invention The force application machine for giving target deceleration to the specimen concerned by merely pushing, without grasping specimens, such as the White body with a wheel of an automobile, An force application control system including an input generating means to output the input signal from the target decelerating wave which should be reproduced to the control means and specimen (CABIN section of the White body of an automobile) which control this force application machine to the above-mentioned control means, After being pushed with an force application machine, it is characterized by having a shock absorber for stopping the specimen which moves by constant speed.

[0010] Moreover, this invention is characterized also by giving target deceleration at the specimen currently carried and fixed by the table cart by pushing a table cart instead of carrying and fixing a specimen and pushing a specimen with an force application machine like the above using a movable table cart smoothly forward and backward.

OPERATION

[Function] In the above-mentioned configuration, a specimen is opposed to an force application (force application machine is seen like [the dummy doll set to the interior]) machine, and the hardpoint of a specimen and the tip of the force application part of an force application machine are contacted. If this force application part is the example of the force application machine which consists of pistons, where the piston of an force application machine is made into the stroke edge by the side of shrinkage, the hardpoint and the piston of a specimen will be contacted. And from this condition, a specimen is pushed with an acceleration control system by actuation of the piston of the force application machine according to control of a control means in order to give target acceleration (it is deceleration for a specimen, i.e., a vehicle) to a specimen. Actuation of a piston will be stopped, if the acceleration of a specimen is set to "0" with target acceleration and full speed is reached. Then, a specimen separates from a piston and shifts to uniform motion mostly by inertia. The condition (condition of 0G) of this acceleration "0" is equivalent to the vehicle speed after an actual vehicle collision "0", i.e., the condition of car-body quiescence, and the dummy doll in a specimen (inside of CABIN of a vehicle) is a part of test evaluation period which is still exercising. The specimen after this evaluation is safely stopped by the shock absorber without damage.

[0012] Moreover, when it considers as the configuration which pushes the table cart concerned with an force application machine using the table cart which carried and fixed the specimen, it is not necessary to necessarily use the White body with a wheel, and it becomes possible as a specimen to use the White body of a mere vehicle.

EXAMPLE

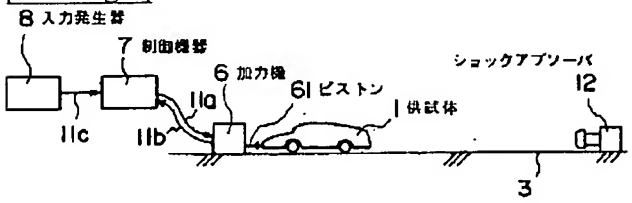
[Example] Hereafter, the example of this invention is explained, referring to a drawing.

DESCRIPTION OF DRAWINGS

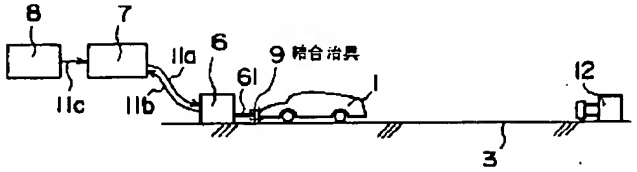
[Brief Description of the Drawings]
[Drawing 1] General drawing of the system concerning the 1st example of this invention.
[Drawing 2] General drawing of the system concerning the 2nd example of this invention.
[Drawing 3] General drawing of the system concerning the 3rd example of this invention.
[Drawing 4] Drawing for explaining the 1st example of the target acceleration which should be reproduced to a specimen.
[Drawing 5] Drawing for explaining the 2nd example of the target acceleration which should be reproduced to a specimen.
[Drawing 6] General drawing of the system concerning the 4th example of this invention.
[Drawing 7] General drawing of the system concerning the 5th example of this invention.
[Drawing 8] General drawing of the system concerning the 6th example of this invention.
[Drawing 9] General drawing of the conventional system.
[Description of Notations]
1 [-- Wire, / 21 -- A specimen (White body without a wheel), 22 / -- Table cart.] -- Specimen (White body with a wheel) 12 -- A shock absorber, 13 2 [4 -- Wall 5 / 7 -- Control equipment 8 / 10 -- A quantity response joint change-over device, 11a-11d -- Control measurement cable / -- An input generator, 9 -- Joint fixture / -- A mechanical stopper, 6 -- Force application machine] -- A winch, 3 -- Transit way

DRAWINGS

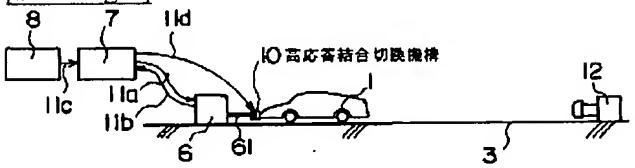
[Drawing 1]



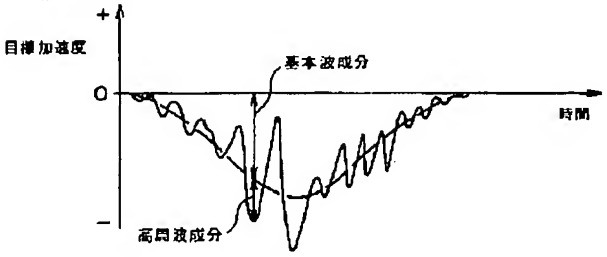
[Drawing 2]



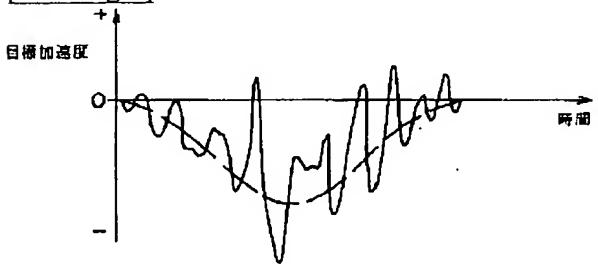
[Drawing 3]



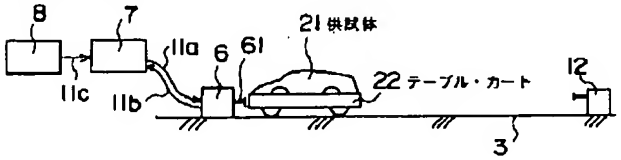
[Drawing 4]



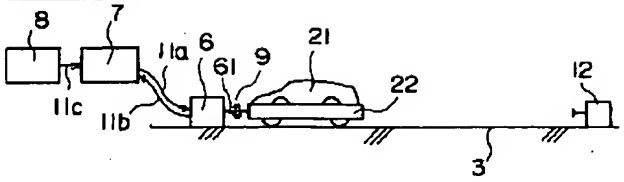
[Drawing 5]



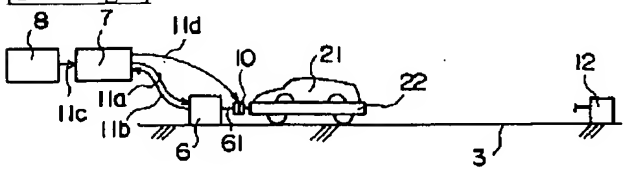
[Drawing 6]



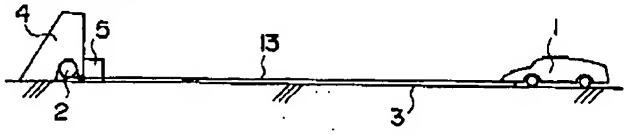
[Drawing 7]



[Drawing 8]



[Drawing 9]



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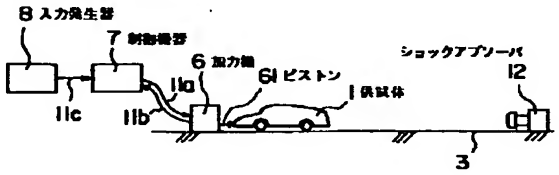
(54)【発明の名称】　車衝突シミュレータ及び車衝突シミュレーション試験方法

(57)【要約】

【目的】自動車の非破壊衝突試験における試験コストの低減、試験時間の短縮、試験精度の向上、試験装置（試験用地）のコンパクト化等を図る。

【構成】供試体（車輪付きホワイトボディ）１を、ダミー人形が加力機６を見るように、加力機６と向かい合わせて配置し、加力機６のピストン６１を縮み側のストローク端にした状態で、このピストン６１を供試体１のハード・ポイントと接触させ、この状態から、供試体１に目標加速度（車にとっては減速度）を与えるべく、入力発生器８から目標減速度波形を設定するための入力信号を制御機器７に与え、その入力信号に従う制御機器７の制御により、加力機６のピストン６１を作動させて供試体１を押す構成とすると共に、加力機６で押された後に定速で移動する供試体１をショックアブソーバ１２で停止させる構成とする。



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【特許請求の範囲】

【請求項1】　自動車の車輪付きホワイトボディ等の供試体を押すことにより当該供試体に目標の減速度を与えるための加力機、この加力機を制御する制御手段及びこの制御手段に対して上記目標減速度を決定するための入力信号を出力する入力発生手段を含む加力制御システムと、

上記加力機で押された後に定速で移動する上記供試体を停止させるためのショック・アブソーバとを具備することを特徴とする車衝突シミュレータ。

【請求項2】　自動車のホワイトボディ等の供試体を搭載・固定して移動可能なテーブル・カートと、

このテーブル・カートを押すことにより上記供試体に目標の減速度を与えるための加力機、この加力機を制御する制御手段及びこの制御手段に対して上記目標減速度を決定するための入力信号を出力する入力発生手段を含む加力制御システムと、

上記加力機で押された後に定速で移動する上記テーブル・カートを停止させるためのショック・アブソーバとを具備することを特徴とする車衝突シミュレータ。

【請求項3】　自動車の車輪付きホワイトボディ等の供試体を加力機により押すことで当該供試体に目標の減速度を与え、しかる後に加力機による加力動作を停止して上記供試体を定速移動させることで、自動車の非破壊衝突シミュレーションを行うと共に、上記定速移動する供試体をショック・アブソーバに停止させるようにしたことを特徴とする車衝突シミュレーション試験方法。

【請求項4】　自動車のホワイトボディ等の供試体をテーブル・カートに搭載・固定して、このテーブル・カートを加力機により押すことで上記供試体に目標の減速度を与え、しかる後に加力機による加力動作を停止して上記テーブル・カートを定速移動させることで、自動車の非破壊衝突シミュレーションを行うと共に、上記定速移動するテーブル・カートをショック・アブソーバに停止させるようにしたことを特徴とする車衝突シミュレーション試験方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は自動車の非破壊衝突試験に好適な車衝突シミュレータ及び車衝突シミュレーション試験方法に関する。

【0002】

【従来の技術】一般に、自動車の衝突試験は、クラッシュ量や残存空間量を評価するための実衝突試験と、エアバッグ・システムやシートベルトに代表される乗員保護具等を評価するための非破壊衝突加速度シミュレーション（非破壊衝突Gシミュレーション）とに大別される。

【0003】本発明は、この後者（非破壊衝突Gシミュレーション）のための非破壊衝突Gシミュレータに関するものである。このGシミュレータでの試験は、剛設計

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された自動車の車輪付きホワイトボディ（供試体）のキャビン部分に目標とする加速度（衝突による車内の減速加速度）を与え、衝突時に乗員保護具や車内レイアウトが中のダミー人形に与える影響を評価し、安全な車を研究開発するために実施されるものである。

【0004】従来、この種の試験は、図9に示すメカニカル方式で実施されてきた。即ち、ダミー人形や乗員保護具をセットした車輪付きのホワイトボディ等の供試体1をウインチ2等でワイヤ13により引張り、走行路3上で目標の速度になったところで、目標加速度が供試体1のキャビン部分に発生するように、壁4等に設けた鉛パッドや油圧ダンパ等のメカニカルストッパ5で供試体1を非破壊に停止させる。

【0005】

【発明が解決しようとする課題】このような従来の試験方法では、以下に列挙する課題があった。

（1）走行路が長くなり（通常、約100m程度）、広大な試験用地を必要とする。

【0006】（2）試験条件が変わるたびに、メカニカルストッパの調整が必要で、試行錯誤による時間ロスも大きく、加速度波形精度やその再現性も悪い。

（3）供試体が損傷する虞がある。

【0007】以上の課題のため、従来の非破壊衝突Gシミュレータによる試験は、供試体数の増加、試験時間の増加及び広大な試験用地等に起因する試験コストの問題と、加速度波形精度等に起因する試験評価上の問題という2大テーマを抱えており、乗務員保護具付きの自動車の価格を下げるために、上記課題を解決する新式Gシミュレータが世界的に切望されている。

【0008】本発明は上記事情を考慮してなされたものでその目的は、自動車の非破壊衝突試験の試験コストの低減及び試験精度の向上が図れる車衝突シミュレータ及び車衝突シミュレーション試験方法を提供することにある。

【0009】

【課題を解決するための手段】本発明に係る車衝突シミュレータ（車衝突加速度シミュレータ）は、自動車の車輪付きホワイトボディ等の供試体を把持せずに、ただ押すことにより当該供試体に目標の減速度を与えるための加力機、この加力機を制御する制御手段及び供試体（自動車のホワイトボディのキャビン部）に再現すべき目標減速度波形から上記制御手段への入力信号を出力する入力発生手段を含む加力制御システムと、加力機で押された後に定速で移動する供試体を停止させるためのショック・アブソーバとを備えたことを特徴とするものである。

【0010】また本発明は、供試体を搭載・固定して前後に滑らかに移動可能なテーブル・カートを用い、上記の如く加力機により供試体を押す代わりに、テーブル・カートを押すことにより、テーブル・カートに搭載・固

定されている供試体に目標の減速度を与えるようにしたことをも特徴とする。

【0011】

【作用】上記の構成において、供試体を（内部にセットされたダミー人形が加力機を見るように）加力機と向かい合わせて、供試体のハード・ポイントと加力機の加力部分の先端を接触させる。この加力部分がピストンで構成されている加力機の例であれば、加力機のピストンを縮み側のストローク端にした状態で供試体のハード・ポイントとピストンを接触させる。そして、この状態から、供試体に目標加速度（供試体、即ち車にとっては減速度）を与えるべく、加速度制御システムにより、制御手段の制御に従う加力機のピストンの作動で供試体を押す。目標加速度と共に供試体の加速度が「0」となり、最高速度に達すると、ピストンの作動が止められる。すると、供試体は、ピストンから離れて慣性でほぼ等速直線運動に移行する。この加速度「0」の状態（0Gの状態）は、実際の車衝突後の車速「0」、即ち車体静止の状態に相当し、供試体中（車のキャビン中）のダミー人形がまだ運動している試験評価期間の一部である。この評価後の供試体は、ショックアブソーバにより、損傷なく安全に停止させられる。

【0012】また、供試体を搭載・固定したテーブル・カートを用い、当該テーブル・カートを加力機により押す構成とした場合には、供試体として、必ずしも車輪付きのホワイトボディを用いる必要はなく、単なる車のホワイトボディを用いることが可能となる。

【0013】

【実施例】以下、図面を参照しながら、本発明の実施例を説明する。

［第1実施例］図1は、本発明の自動者用非破壊衝突Gシミュレータ（自動者用非破壊衝突加速度シミュレータ）の第1実施例を示すシステム構成図である。なお、図9と同一部分には同一符号を付してある。

【0014】図1において、6はピストン61を備えた加力機である。この加力機6は、ピストン61を駆動することで、（ダミー人形や乗員保護具をセットした自動車の車輪付きのホワイトボディ等の）供試体1を把持せずに当該供試体1に目標とする減速度を与えることが可能なようになっている。加力機6のピストン61には、位置センサ及び加速度センサ（図示せず）が装着されている。

【0015】加力機6には、当該加力機6を制御するための制御機器7が制御計測ケーブル11a，11bを介して接続されている。また、制御機器7には、供試体1のキャビン部に再現すべき目標減速度波形から決定される当該制御機器7への入力信号を出力する入力発生器8が、制御計測ケーブル11cを介して接続されている。

【0016】以上の加力機6、制御機器7、入力発生器8及び加力機6のピストン61に装着された位置センサ及び加速度センサは、加力制御システムを構成する。この加力制御システム（の加力機6）は、例えば電気－油圧サーボ式、或いは動電式等のアクチュエータにより実現される。

【0017】加力機6のピストン61先端の前方には、加力機6で押された後、定速で移動する供試体1を損傷なく停止させるためのショックアブソーバ12が設けられている。

【0018】次に、図1の構成の自動者用非破壊衝突Gシミュレータによる非破壊衝突試験（非破壊衝突Gシミュレーション試験）について説明する。まず、供試体1を、当該供試体1にセットされたダミー人形が加力機6を見るように、加力機6と向かい合わせて配置し、加力機6のピストン61を縮み側のストローク端にした状態で、このピストン61を供試体1のハード・ポイントと接触させる。

【0019】この状態から、供試体1に目標加速度（供試体1、即ち車にとっては減速度）を与えるべく、加速度制御システムにより、即ち入力発生器8から目標減速度波形を設定するための入力信号を制御機器7に与え、その入力信号に従う制御機器7の制御により、加力機6のピストン61を作動させて供試体1を押す。この入力信号は、目標減速度波形に対応する目標変位波形である。この目標変位波形の最も簡便な決定方法は、目標減速度波形（目標加速度波形）を2回積分することである。但し、計算だけで変位波形を決定した場合、制御機器7のフィードバック制御によりこの変位波形が高精度に再現されたとしても、加速度センサによりモニタされる実際の加速度波形は必ずしも目標加速度波形に一致するとは限らない。このような場合、目標変位波形を入力発生器8から制御機器7に与えて、供試体1（を押すピストン61）の変位が当該目標変位波形に一致するように、制御機器7により加力機6をフィードバック制御させながら、加力機6のピストン61に装着された加速度センサにより検出される加速度（応答加速度）をモニタする。そして、このモニタした加速度（応答加速度）と目標加速度とのずれから、より目標加速度に近づけることが可能な、実際の制御系に適合した目標変位波形を決定し、入力発生器8より出力させる。この手続きを何回か繰り返すことにより、目標加速度波形を与える最適な目標変位波形が決定される。

【0020】さて制御機器7は、供試体1の変位及び加速度を、ピストン61に装着された位置センサ及び加速度センサにより検出しながら、供試体1の変位が目標変位波形に一致するように、加力機6をフィードバック制御する。そして制御機器7は、目標加速度と共に供試体1の加速度が「0」となり、最高速度に達したことを検出すると、ピストン61の作動を止める。

【0021】こうすると、供試体1は、ピストン61から離れて慣性でほぼ等速直線運動に移行する。この加速

度「０」の状態（０Ｇの状態）は、実際の車衝突後の車速「０」、即ち車体静止の状態に相当し、供試体１中（車のキャビン中）のダミー人形がまだ運動している試験評価期間の一部である。この評価後の供試体１は、ショックアブソーバ１２により、損傷なく安全に停止させられる。

【００２２】以上に述べた図１の構成の自動者用非破壊衝突Ｇシミュレータでは、上記加力制御システムと供試体１から構成される制御系の周波数応答特性が目標加速度波形の主要周波数成分に比べて充分高い場合には、上記の加力制御機能により、即ち供試体１を（ダミー人形が加力機６を見るように）加力機６と向かい合わせ、加力機６のピストン６１を縮み側のストローク端にした状態で供試体１のハード・ポイントとピストン６１を接触させ、この状態から供試体１に目標加速度を与えることにより、所期の試験目的を達成できる。

【００２３】これに対し、加力制御システムと供試体１から構成される制御系の周波数応答特性が目標加速度波形の主要周波数成分に比べて充分高いとはいえない場合には、図１の構成では不十分である。

【００２４】［第２実施例］そこで、加力制御システムと供試体１から構成される制御系の周波数応答特性が目標加速度波形の主要周波数成分に比べて充分高いとはいえない場合に好適な、本発明の第２実施例について、図２を参照して説明する。なお、図１と同一部分には同一符号を付して詳細な説明を省略する。

【００２５】まず本実施例では、制御系の周波数応答特性が目標加速度波形の主要周波数成分に比べて充分高いとはいえない場合、予め試加振により把握した制御系の周波数応答特性を使って目標加速度波形を補償し、これを入力とする手法（いわゆる入力補償手法）を適用するようにしている。

【００２６】この入力補償手法を適用する場合、試加振時には、通常、適当な入力波で供試体１を押し引きする振動加振が行われる。そこで本実施例では、この振動加振（試加振）のために、図２に示すように、供試体１のハード・ポイントと加力機６のピストン６１先端とを、ボルト等の結合治具９で結合するようにしている。

【００２７】そして、供試体１のハード・ポイントと加力機６のピストン６１先端とを結合治具９で結合した状態で、加力機６のピストン６１を伸縮して供試体１を押し引きする振動加振（試加振）を行い、加力システムと供試体１から構成される制御系の周波数応答特性を抽出した後の本加振（非破壊衝突Ｇシミュレーション）時には、結合治具９を外して結合を解き、図１に示した前記第１実施例と同様のシステム状態にしておく。この状態での本加振時の機能は、上記の試加振により把握した制御系の周波数応答特性を使って目標加速度波形を補償し、これを入力発生器８からの入力とする点を除けば、前記第１実施例と同様である。

【００２８】ところで、以上の第１及び第２実施例が適用可能となるためには、次に述べるように目標加速度に条件が付く。通常、目標加速度は、図４に示すように、ハーフ・サイン状の基本波の上に、数１００Ｈｚの高周波が乗っている。この図４の例のように、目標加速度が“＋”（プラス）になる時間帯がなかったり、たとえ“＋”になる時間があっても試験目的から、その時間の加速度を「０」でカットしたりしても良い場合に、第１及び第２実施例が適用可能となる。

【００２９】これに対し、目標加速度が上記の条件を満足しない場合、例えば図５のように目標速度が“＋”（プラス）になる時間帯がある場合には、第１及び第２実施例では不十分である。

【００３０】［第３実施例］そこで、目標加速度が図５のような場合に好適な本発明の第３実施例について、図３を参照して説明する。なお、図１と同一部分には同一符号を付して詳細な説明を省略する。

【００３１】まず本実施例では、図３に示すように、供試体１のハード・ポイントと加力機６のピストン６１先端との結合と結合解除を可能とする、油圧チャックや電磁石等により構成される高応答結合切換機構１０が設けられる。この高応答結合切換機構１０は制御計測ケーブル１１ｄを介して制御機器７から制御される。即ち高応答結合切換機構１０は、目標加速度が“＋”と“－”とに大きく変動している期間は、供試体１のハード・ポイントと加力機６のピストン６１先端とを結合し、加速度が「０」持続となる瞬間に、制御機器７から制御計測ケーブル１１ｄを介して与えられる同期信号により高応答に上記の結合を解除する。

【００３２】このような構成においては、前記第２実施例で述べたような入力補償が必要な場合でも、試加振時に高応答結合切換機構１０を常時結合状態に設定しておき、結合状態のまま系の周波数特性把握を実施し、この後の本加振（非破壊衝突Ｇシミュレーション）では、制御機器７からの同期信号により高応答結合切換機構１０を結合状態から解除して切り換えれば良い。

【００３３】以上の第１乃至第３実施例によれば、以下に列挙する実施例効果を得ることができる。

（１）供試体１の走行距離は、試験時の目標速度と上記「０Ｇ」の試験評価時間との積で決まり、高々１０ｍ程度以下の短距離で納まる。

【００３４】（２）加力機６の全ストロークは目標加速度波形を２回積分した値程度であり、高々１ｍ以下に納まる。この短ストロークのため、例えば電気－油圧サーボ式で問題となる加力機６の油柱剛性の低下もなく、高周波での大Ｇ加振が可能であり、フィードバック制御方式とも相まって加速度波形精度と再現性に優れた高効率システムとなる。

【００３５】（３）ショックアブソーバ１２には、試験目的からの制限は無く、いくらでも加速度を小さくする

設計が可能であり、このため、事実上、供試体1を何ら損傷なく、無傷で安全に停止させることができる。

【0036】上記した実施例効果（1）～（3）は、［発明が解決しようとする課題］の欄で述べた課題（1）～（3）に対応するもので、本実施例による新規なGシミュレータは、従来のGシミュレータが有する主要課題を全て解決しており、新たな課題はない。

【0037】なお、以上の第1乃至第3実施例において、供試体1の向きを図とは反対（ダミー人形が加力機6に背を向ける状態）にして、ショックアブソーバ12を剛な衝突壁で置き換えると、［従来の技術］の欄で述べた通常の破壊衝突試験が実施できるのは勿論である。

【0038】また、以上の第1乃至第3実施例では、供試体1を車輪付きのホワイトボディ等であるとして、図1乃至図3に示したように、加力機6のピストン61の作動により、供試体1を直接押すようにしたが、これに限るものではない。

【0039】例えば、車の単なるホワイトボディを供試体として用い、当該供試体を搭載・固定して前後に滑らかに移動可能なテーブル・カートを設け、このテーブル・カートを加力機により押すことにより、前記第1乃至第3実施例と同様に所期の試験目的を達成可能である。

【0040】このテーブル・カートを用いた（前記第1乃至第3実施例に対応する）第4乃至第6実施例を、（図1乃至図3に対応する）図6乃至図8を参照して説明する。なお、図1乃至図3と同一部分には同一符号を付して詳細な説明を省略する。

【0041】［第4実施例］本実施例では、図6に示すように、供試体21を搭載・固定して前後に滑らかに移動可能なテーブル・カート22が設けられる。図6に示す供試体21は車の単なるホワイトボディ（車輪無しのホワイトボディ）であり、この点で、図1乃至図3に示したような、車輪付きのホワイトボディである供試体1とは異なる。

【0042】図6の構成では、供試体21を搭載・固定したテーブル・カート22を加力機6と向かい合わせ、加力機6のピストン61を縮み側のストローク端にした状態で、このピストン61をテーブル・カート22と接触させる。

【0043】この状態から、供試体21に目標加速度（供試体21、即ち車にとっては減速度）を与えるべく、加速度制御システムにより、即ち入力発生器8から目標減速度波形を設定するための入力信号を制御機器7に与え、その入力信号に従う制御機器7の制御により、加力機6のピストン61を作動させてテーブル・カート22を押す。制御機器7は、目標加速度と共にテーブル・カート22の加速度が「0」となり、最高速度に達したことを検出すると、ピストン61の作動を止める。

【0044】こうすると、テーブル・カート22は、ピストン61から離れて慣性でほぼ等速直線運動に移行する。この加速度「0」の状態（0Gの状態）は、実際の車衝突後の車速「0」、即ち車体静止の状態に相当し、供試体21中（車のキャビン中）のダミー人形がまだ運動している試験評価期間の一部である。この評価後の供試体21は、ショックアブソーバ12により、テーブル・カート22と共に損傷なく安全に停止させられる。

【0045】以上に述べた図6の構成の自動者用非破壊衝突Gシミュレータでは、上記加力制御システムと供試体21及びテーブル・カート22から構成される制御系の周波数応答特性が目標加速度波形の主要周波数成分に比べて充分高い場合には、上記の加力制御機能により所期の試験目的を達成できる。

【0046】そうでない場合には、図6の構成では不十分であり、次の第5実施例を適用する必要がある。

［第5実施例］本実施例は、前記第2実施例と同様に、入力補償手法を適用するもので、試加振時には、通常、適当な入力波でテーブル・カート22を押し引きする振動加振を行うために、図7に示すように、テーブル・カート22の端部と加力機6のピストン61先端とを、結合治具9で結合するようにしている。この後の本加振（非破壊衝突Gシミュレーション）時には、結合治具9を外して結合を解いておく。この状態での本加振時の機能は、第4実施例と同様である。

【0047】ところで、図5に示したように、目標速度が“＋”（プラス）になる時間帯がある場合には、第4及び第5実施例では不十分である。

［第6実施例］そこで、目標加速度が図5のような場合に適用し得るように、図8に示す如く高応答結合切換機構10を用い、目標加速度が“＋”と“－”とに大きく変動している期間は、当該高応答結合切換機構10によりテーブル・カート22の端部と加力機6のピストン61先端とを結合し、加速度が「0」持続となる瞬間に、高応答に上記の結合を解除する構成をとる。

【0048】以上の第4乃至第6実施例によれば、以下に列挙する実施例効果を得ることができる。

（1）テーブル・カート22の走行距離は、試験時の目標速度と上記「0G」の試験評価時間との積で決まり、高々10m程度以下の短距離で納まる。

【0049】（2）加力機6の全ストロークは目標加速度波形を2回積分した値程度であり、高々1m以下に納まる。この短ストロークのため、例えば電気－油圧サーボ式で問題となる加力機6の油柱剛性の低下もなく、高周波での大G加振が可能であり、フィードバック制御方式とも相まって加速度波形精度と再現性に優れた高効率システムとなる。

【0050】（3）ショックアブソーバ12には、試験目的からの制限は無く、いくらでも加速度を小さくする設計が可能であり、このため、事実上、供試体21やテーブル・カート22を何ら損傷なく、無傷で安全に停止させることができる。

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【0051】上記した実施例効果（1）～（3）は、［発明が解決しようとする課題］の欄で述べた課題（1）～（3）に対応するもので、本実施例による新規なGシミュレータは、従来のGシミュレータが有する主要課題を全て解決している。

【0052】

【発明の効果】以上詳述したように本発明によれば、従来の車衝突Gシミュレータが有する主要課題を全て解決して、試験コストの低減、試験時間の短縮、試験精度の向上、試験装置（試験用地）のコンパクト化、更に騒音の低減が図れ、したがって乗員保護具付きの自動車の価格低下が期待できる。

【図面の簡単な説明】

【図1】本発明の第1実施例に係るシステムの全体図。

【図2】本発明の第2実施例に係るシステムの全体図。

【図3】本発明の第3実施例に係るシステムの全体図。

【図4】供試体に再現すべき目標加速度の第1の例を説明するための図。

【図5】供試体に再現すべき目標加速度の第2の例を説明するための図。

【図6】本発明の第4実施例に係るシステムの全体図。

【図7】本発明の第5実施例に係るシステムの全体図。

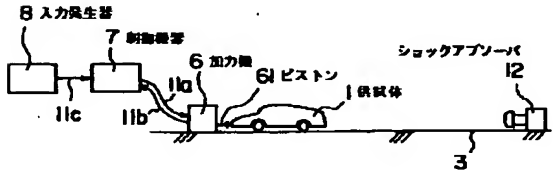
【図8】本発明の第6実施例に係るシステムの全体図。

【図9】従来のシステムの全体図。

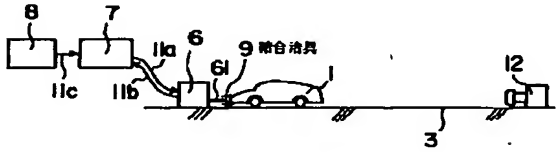
【符号の説明】

1…供試体（車輪付きのホワイトボディ）、　2…ウインチ、3…走行路　4…壁、5…メカニカルストッパ、6…加力機、　7…制御機器、　8…入力発生器、9…結合治具、10…高応答結合切換機構、11a～11d…制御計測ケーブル、　12…ショックアブソーバ、13…ワイヤ、　21…供試体（車輪無しのホワイトボディ）、22…テーブル・カート。

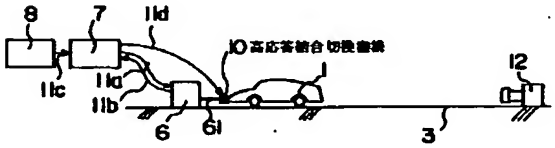
【図1】



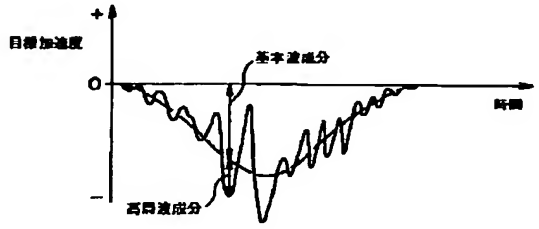
【図2】



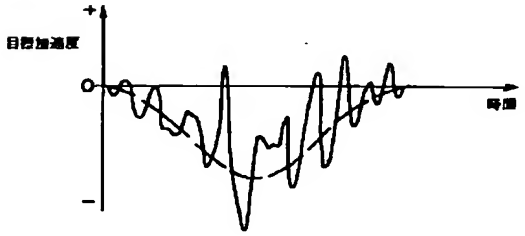
【図3】



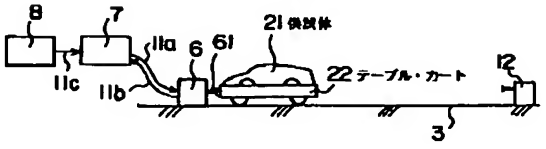
【図4】



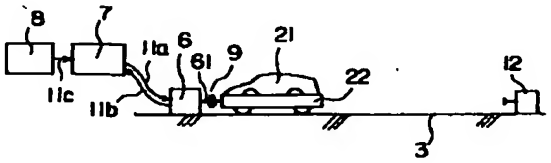
【図5】



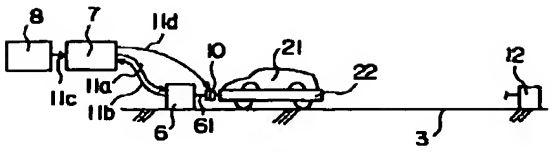
【図6】



【図7】



【図8】



【図9】